

WE CLAIM:

1. A component, comprising:
a silicon-based substrate; and
a diffusion barrier coating disposed on said substrate, wherein
said diffusion barrier coating comprises:
5 a first isolation layer disposed on said silicon-based
substrate;
a first oxygen barrier layer disposed on said first isolation
layer; and
a second isolation layer disposed on said first oxygen
10 barrier layer,
wherein said first oxygen barrier layer comprises a SiO₂-
based material, and
wherein said first isolation layer and said second isolation
layer each comprise a material selected from the group consisting of Ta₂O₅,
15 Ta₅Si₃, TaSi₂, MoSi₂, Mo₅Si₃, Si₃N₄, Si₂N₂O, and SiC.
2. The component of claim 1, further comprising:
a second oxygen barrier layer disposed on said second isolation
layer; and
a third isolation layer disposed on said second oxygen barrier
5 layer.
3. The component of claim 1, further comprising:
an environmental barrier coating disposed on said diffusion barrier
coating.
4. The component of claim 3, wherein said environmental barrier
coating comprises at least one oxide of an element selected from the group

consisting of Ta, Al, Cr, Hf, Ti, Zr, Mo, Nb, Ni, Sr, Mg, Si, and the rare earth elements including Sc, Y, and the lanthanide series of elements.

5. The component of claim 4, wherein said environmental barrier coating comprises at least about 50 mole % AlTaO_4 .

6. The component of claim 3, further comprising:
a thermal barrier coating disposed on said environmental barrier coating.

7. The component of claim 1, wherein said first oxygen barrier layer comprises a material selected from the group consisting of a silicate glass and crystalline silica.

8. The component of claim 1, wherein said first oxygen barrier layer comprises silica and at least one oxide of an element selected from the group consisting of Ta, Al, Cr, Hf, Ti, Zr, Mo, Nb, Ni, Sr, Mg, Si, and the rare earth elements including Sc, Y, and the lanthanide series of elements.

9. The component of claim 1, wherein said first isolation layer and said second isolation layer have the same composition.

10. The component of claim 1, wherein:
said first isolation layer consists essentially of silicon nitride;
said second isolation layer consists essentially of Ta_2O_5 ; and
said first oxygen barrier layer is formed *in situ* by reaction of said
5 silicon nitride with said Ta_2O_5 .

11. The component of claim 1, wherein said first oxygen barrier layer has a thickness in the range of from about 1 to 20 microns.

12. The component of claim 1, wherein said first and second isolation layers each have a thickness in the range of from about 1 to 100 microns.

13. A component, comprising:
a silicon-based substrate; and
a diffusion barrier coating disposed on said substrate, wherein said diffusion barrier coating comprises:

5 a first isolation layer disposed on said silicon-based substrate;

a first oxygen barrier layer disposed on said first isolation layer;

10 a second isolation layer disposed on said first oxygen barrier layer; and

an environmental barrier coating disposed on said diffusion barrier coating,

wherein said first oxygen barrier layer provides a barrier to the diffusion of oxygen therethrough, and

15 wherein each of said first isolation layer and said second isolation layer comprises a material selected from the group consisting of Ta_2O_5 , Ta_5Si_3 , $TaSi_2$, $MoSi_2$, Mo_5Si_3 , Si_3N_4 , Si_2N_2O , and SiC .

14. The component of claim 13, further comprising a thermal barrier coating disposed on said environmental barrier coating, and wherein said environmental barrier coating comprises $AlTaO_4$ or Ta_2O_5 .

15. The component of claim 13, wherein said thermal barrier coating comprises yttria stabilized zirconia or yttria stabilized hafnia.

16. A component, comprising:
- a silicon-based substrate;
 - a first isolation layer disposed on said silicon-based substrate, wherein said first isolation layer comprises a material selected from the group consisting of Ta₂O₅, Ta₅Si₃, TaSi₂, MoSi₂, Mo₅Si₃, Si₃N₄, Si₂N₂O, and SiC;
 - a first oxygen barrier layer disposed on said first isolation layer, wherein said first oxygen barrier layer comprises a material selected from the group consisting of a silicate glass, and crystalline silica; and
 - a second isolation layer disposed on said first oxygen barrier layer, wherein said second isolation layer comprises a material selected from the group consisting of Ta₂O₅, Ta₅Si₃, TaSi₂, MoSi₂, Mo₅Si₃, Si₃N₄, Si₂N₂O, and SiC,
- wherein said first oxygen barrier layer has a thickness in the range of from about 1 to 20 micron, and
- wherein said first and second isolation layers each have a thickness in the range of from about 1 to 100 micron.

17. A component, comprising:
a silicon-based substrate; and
a diffusion barrier coating disposed on said substrate, wherein
said diffusion barrier coating comprises:

- 5 a plurality of isolation layers, at least one of said plurality of
isolation layers disposed on said silicon-based substrate; and
one or more oxygen barrier layers, each of said one or
more oxygen barrier layers disposed between two of said plurality of isolation
layers; wherein
10 each of said one or more oxygen barrier layers comprises a
SiO₂-based material, and
each of said plurality of isolation layers comprises a
material selected from the group consisting of Ta₂O₅, Ta₅Si₃, TaSi₂, MoSi₂,
Mo₅Si₃, Si₃N₄, Si₂N₂O, and SiC.

18. The component of claim 17, wherein:
said one or more oxygen barrier layers consist of n oxygen barrier
layers, and
said plurality of isolation layers consist of (n+1) isolation layers,
5 wherein n is an integer in the range of from 1 to 5.

19. A component, comprising:
a silicon-based substrate; and
a diffusion barrier coating disposed on said substrate, wherein
said diffusion barrier coating comprises:

5 a first isolation layer disposed on said silicon-based
substrate;

a first oxygen barrier layer disposed on said first isolation
layer;

a second isolation layer disposed on said first oxygen
10 barrier layer; and

an environmental barrier coating disposed on said second
isolation layer,

wherein said first oxygen barrier layer serves as a barrier to
the diffusion of oxygen therethrough,

15 wherein said first isolation layer is inert to said silicon-based
substrate, and

wherein said second isolation layer is inert to said
environmental barrier coating.

20. A diffusion barrier coating for a silicon-based substrate, comprising:

a first isolation layer;

a first oxygen barrier layer disposed on said first isolation layer;

5 and

a second isolation layer disposed on said first oxygen barrier layer,

wherein said first oxygen barrier layer comprises a SiO₂-based material, and

10 wherein each of said first isolation layer and said second isolation layer comprises a material selected from the group consisting of Ta₂O₅, Ta₅Si₃, TaSi₂, MoSi₂, Mo₅Si₃, Si₃N₄, Si₂N₂O, and SiC.

21. The diffusion barrier coating of claim 20, wherein said first isolation layer is disposed on said silicon-based substrate.

22. A component, comprising:

a silicon-based substrate; and

a diffusion barrier coating disposed on said substrate, wherein said diffusion barrier coating comprises:

5 an isolation layer disposed on said silicon-based substrate;

a first oxygen barrier layer disposed on said first isolation layer; and

a second oxygen barrier layer disposed on said first oxygen barrier layer,

10 wherein each of said first oxygen barrier layer and said second oxygen barrier layer provides a barrier to the diffusion of oxygen therethrough.

23. The component of claim 22, wherein said isolation layer comprises a material selected from the group consisting of Ta_2O_5 , Ta_5Si_3 , $TaSi_2$, $MoSi_2$, Mo_5Si_3 , Si_3N_4 , Si_2N_2O , and SiC .

24. The component of claim 22, wherein each of said first oxygen barrier layer and said second oxygen barrier layer comprise a material selected from the group consisting of SiO_2 , $ScSiO_5$, and $Sc_2Si_2O_7$.

25. The component of claim 22, further comprising:
an environmental barrier coating disposed on said diffusion barrier coating, and wherein said environmental barrier coating comprises at least about 50 mole % $AlTaO_4$.

26. The component of claim 25, further comprising:
a thermal barrier coating disposed on said environmental barrier coating.

27. A method for making a component, the method comprising:
a) providing a silicon-based substrate;
b) forming a first isolation layer on said silicon-based substrate;
c) forming a first oxygen barrier layer on said first isolation layer;
5 and
d) forming a second isolation layer on said first oxygen barrier layer,
wherein said first isolation layer isolates said oxygen barrier layer from said silicon-based substrate, and
10 wherein said first isolation layer is inert to said silicon-based substrate.

28. The method of claim 27, wherein said first isolation layer comprises a material selected from the group consisting of Ta_2O_5 , Ta_5Si_3 , $TaSi_2$, $MoSi_2$, Mo_5Si_3 , Si_3N_4 , Si_2N_2O , and SiC.

29. The method of claim 27, wherein said first oxygen barrier layer provides a barrier to the diffusion of oxygen therethrough.

30. The method of claim 27, wherein said first isolation layer provides a barrier to the diffusion of constituents of said silicon-based substrate into said first oxygen barrier layer.

31. The method of claim 27, further comprising:

e) forming an environmental barrier coating on said second isolation layer,

5 wherein said second isolation layer provides a barrier to the diffusion of constituents of said environmental barrier coating into said first oxygen barrier layer.

32. The method of claim 31, further comprising:

f) forming a thermal barrier coating on said environmental barrier coating.

33. The method of claim 27, wherein said first isolation layer, said oxygen barrier layer, and said second isolation layer are deposited via a process selected from the group consisting of plasma spray coating, dip coating, sol-gel coating, chemical vapor deposition, physical vapor deposition,
5 and electron beam physical vapor deposition.

34. The method of claim 27, wherein said step b) and said step d) respectively comprise depositing said first isolation layer and said second isolation layer via chemical vapor deposition.

35. The method of claim 27, further comprising:

g) sequentially forming at least one additional oxygen barrier layer and at least one additional isolation layer on said second isolation layer.

36. A method for making a component, the method comprising:

- a) providing a silicon-based substrate;
- b) forming a first isolation layer on said silicon-based substrate;
- c) forming a first oxygen barrier layer on said first isolation layer;
- 5 d) forming a second isolation layer on said first oxygen barrier layer; and
- e) forming an environmental barrier coating on said second isolation layer,
- 10 wherein said first oxygen barrier layer comprises silicate glass, and
- wherein said first isolation layer and said second isolation layer each comprise a material selected from the group consisting of Ta_2O_5 , Ta_5Si_3 , $TaSi_2$, $MoSi_2$, Mo_5Si_3 , Si_3N_4 , Si_2N_2O , and SiC.

37. The method of claim 36, further comprising:

- f) prior to said step e), forming a second oxygen barrier layer on said second isolation layer; and
- 5 g) prior to said step e), forming a third isolation layer on said second oxygen barrier layer.

38. A method for making a component, the method comprising:
- a) providing a silicon-based substrate;
 - b) forming a first isolation layer on said silicon-based substrate;
- and
- 5 c) forming a second isolation layer on said first isolation layer, wherein said first isolation layer consists essentially of Si_3N_4 and said second isolation layer consists essentially of Ta_2O_5 .

39. The method of claim 38, further comprising:

- d) reacting said first isolation layer with said second isolation layer to form, *in situ*, an oxygen barrier layer between said first isolation layer and said second isolation layer.

40. The method of claim 39, wherein said step d) is performed during service conditions of said component.

41. A method for making a component, the method comprising:
- a) providing a silicon-based substrate;
 - b) forming an isolation layer on said silicon-based substrate;
 - c) forming a first oxygen barrier layer on said isolation layer; and
- 5 d) forming a second oxygen barrier layer on said first oxygen barrier layer,
- wherein said isolation layer isolates said oxygen barrier layer from said silicon-based substrate, and
- wherein said isolation layer is inert to said silicon-based substrate.

42. The method of claim 41, wherein said isolation layer comprises a material selected from the group consisting of Ta_2O_5 , Ta_5Si_3 , TaSi_2 , MoSi_2 , Mo_5Si_3 , Si_3N_4 , $\text{Si}_2\text{N}_2\text{O}$, and SiC .

43. The method of claim 41, wherein said first oxygen barrier layer and said second oxygen barrier layer each comprise a material selected from the group consisting of SiO_2 , ScSiO_5 , and $\text{Sc}_2\text{Si}_2\text{O}_7$.

44. The method of claim 41, wherein said isolation layer provides a barrier to the diffusion of constituents of said silicon-based substrate into said first oxygen barrier layer.

45. The method of claim 41, further comprising:
e) forming an environmental barrier coating on said second oxygen barrier layer.

46. The method of claim 45, further comprising:
f) forming a thermal barrier coating on said environmental barrier coating.

47. The method of claim 41, wherein said isolation layer, said first oxygen barrier layer, and said second oxygen barrier layer are deposited via a process selected from the group consisting of plasma spray coating, dip coating, sol-gel coating, chemical vapor deposition, physical vapor deposition, and electron beam physical vapor deposition.

48. The method of claim 41, further comprising:
g) forming at least one additional oxygen barrier layer on said second oxygen barrier layer.